

# Aortic origin of conus coronary artery

## *Evidence of postnatal coronary development\**

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**SUMMARY** The conus coronary artery has been reported to arise independently from the aorta in approximately 45 per cent of hearts. In this study, 305 necropsy specimens were examined to determine the origin of the conus coronary artery and variations in patterns of origin with respect to age. Three patterns were recognised: 1, in which the conus artery arose from the aorta independently of the right coronary artery; 2, in which the conus artery and the right coronary artery arose from a common ostium; and 3, in which only the right coronary artery took origin from the right aortic sinus. The relative incidence of the three patterns varied with age. Pattern 1 was recognised in 14 to 24 per cent of specimens from patients under the age of 2 years, whereas in older patients, it occurred in 41 to 63 per cent. These data suggest that aortic origin of the conus arterial ostium may appear in some individuals between 2 and 4 years of age, and they support the concept that some coronary arterial patterns are not fully established at the time of birth.

The existence of a "third" coronary artery, the conus artery, has been known since the days of Morgagni. It was not until the work by Schlesinger's group in the late 1940s, however, that this vessel became commonly recognised.<sup>1</sup> Schlesinger described the conus artery as supplying the conus arteriosus (right ventricular infundibulum or outflow tract) and recognised that it either arose as an independent vessel from the right aortic sinus or took origin as the first branch of the right coronary artery. The conus artery may be an important source for collateral coronary blood flow through a vascular anastomotic bridge (circle of Vieussens) between the right and left coronary systems.

The reported frequency of independent aortic origin of the conus artery has ranged from 33 to 50 per cent of all individuals.<sup>1-5</sup> Though the embryological development of the coronary arterial circulation in humans is not well understood, Reiner and colleagues<sup>6</sup> stated that "the coronary patterns are established at birth and do not change with postnatal growth of the heart".

We have, however, observed that, in general, aortic origin of the conus artery is uncommon in

neonates and quite frequent in adults. This observation suggests that postnatal changes occur in the coronary arterial system. The incidence of aortic origin of the conus coronary artery was determined in 305 normal hearts obtained at necropsy from subjects ranging in age from the fetal state to adulthood. These findings form the basis of this report.

### Subjects and methods

From the Tissue Registry of the Mayo Clinic, 305 normal hearts were obtained from subjects ranging in age from 28 fetal weeks to 79 years. Hearts with congenital anomalies or those in which calcification of the aortic sinuses could potentially have obliterated small conus ostia were not included in the study. When the hearts had been obtained at the time of necropsy, they were opened in standard fashion exposing the aortic valve and its related structures, including the ostia of the coronary arteries.

The right aortic sinus of Valsalva was examined in each heart to determine the presence or absence of a conus arterial ostium (Fig. 1). A stereoscopic dissecting microscope was used for fetal and neonatal hearts. Arteries arising anteriorly to the right coronary ostium were considered conus

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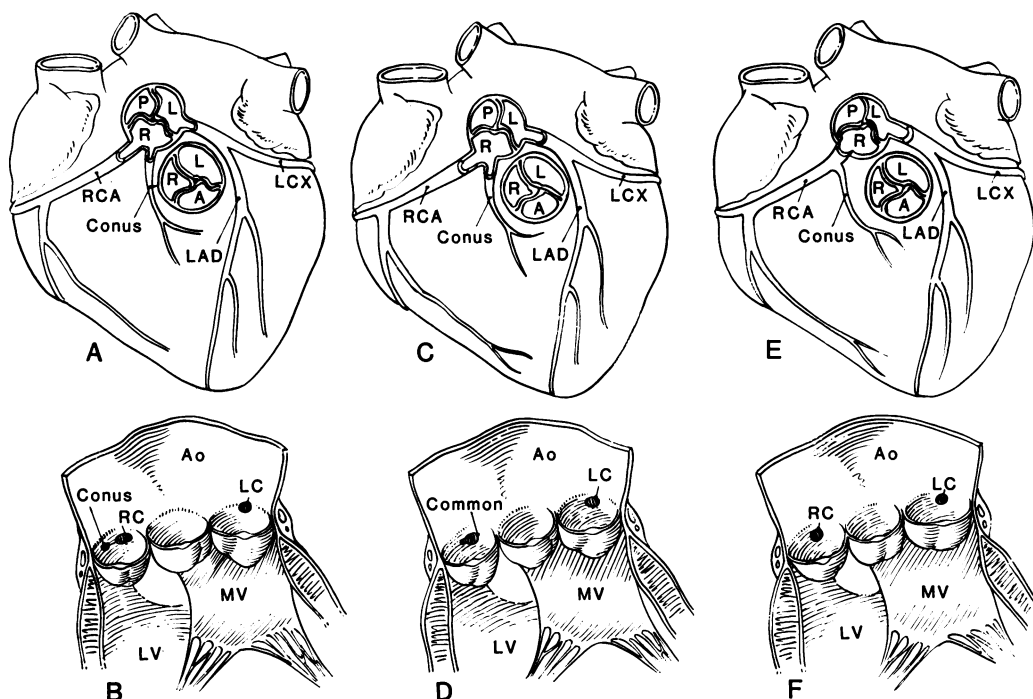
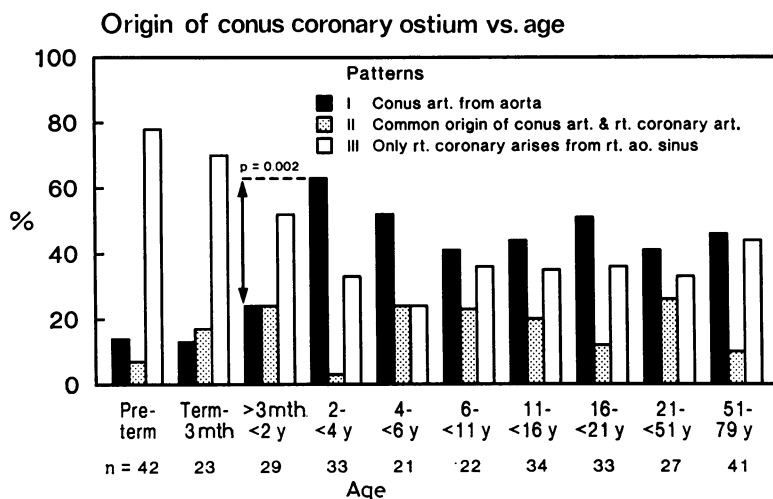


Fig. 1 Variations in patterns of conus arterial origin, viewed externally (A, C, E) and internally (B, D, F). A, B: pattern 1. Independent origins of the conus and right coronary (RCA) arteries from the aorta (Ao). C, D: pattern 2. Common origin of conus artery and RCA. E, F: pattern 3. Only the right coronary artery arises from the right aortic sinus. LAD=left anterior descending coronary artery, LC=left coronary ostium, LCX=left circumflex coronary artery, LV=left ventricle, MV=anterior leaflet of mitral valve, RC=right coronary ostium.

Fig. 2 Incidence of patterns of conus coronary arterial origin in various age groups. Aortic origin of the conus artery (pattern 1) increases dramatically at 2 to 4 years, compared with that observed in the younger age groups, and does not change significantly in the older age groups.



arteries, regardless of their size or number. Uncommonly, an artery would arise posteriorly to the right coronary artery; such vessels were not considered to be conus arteries. Three patterns were found. These were 1: aortic origin of one or

more conus ostia (119 cases); 2: aortic origin of both the conus and right coronary arteries from a single, or common, ostium (47 cases); and 3: a solitary aortic right coronary ostium with presumed origin of the conus artery from the proximal portion

of the right coronary artery (139 cases). The subjects were divided into age groups, as shown in Fig. 2. Between these groups, the incidence of aortic origin of the conus artery was compared using the  $\chi^2$  test, assuming statistical significance at  $p < 0.01$ .

## Results

The incidence of pattern 1 (independent aortic origin of the conus artery) in the groups under 2 years of age ranged from 14 to 24 per cent. From 2 to less than 4 years of age, the incidence of pattern 1 was highest for any age group, being 63 per cent; and from 4 to 79 years, it ranged from 41 to 52 per cent. The 63 per cent incidence in the age group 2 to less than 4 years was significantly different ( $p = 0.002$ ) from younger age groups but not from the older groups (Fig. 2).

Of those cases with pattern 1, 32 had multiple conus ostia (26 with two ostia; five with three ostia; and one with four ostia). The incidence of multiple conus ostia, however, was not age-related.

The incidence of pattern 2 (common aortic ostium for conus and right coronary arteries) varied widely among the age groups (3 to 26%) but the differences did not appear to be statistically significant. The age group (2 to less than 4 years) with the highest incidence of pattern 1 had the lowest incidence of pattern 2.

The incidence of pattern 3 (solitary right coronary ostium) progressively declined, from a preterm level of 78 per cent to 24 per cent at age 4 to less than 6 years. After the age of 6, the incidence remained stable, ranging from 33 to 44 per cent.

The relative incidence of the three patterns of conus arterial origin was not related to the sex of the subjects in any age group.

## Comment

The incidence of aortic origin of the conus artery was significantly higher in subjects older than 2 years of age than in those who were younger. While the incidence was greater in the group between 2 and 4 years than in all older groups, this difference was not significant.

Schlesinger and associates,<sup>1</sup> in their classic study of the conus coronary artery, found no change in the incidence of aortic origin of the conus artery with respect to age. Though they examined 651 hearts, only 24 were from subjects less than 19 years old, so few and over such a broad age range as to obscure any age-related changes in the very young. In our study, 148 specimens from subjects less than 6 years of age (Fig. 2) were examined.

When these were subdivided into smaller age groups, the differences in incidence became apparent.

There are three potential explanations for the significantly higher incidence, in subjects aged 2 years or more than in younger subjects, of aortic origin of the conus artery.

Firstly, a failure of identification of conus arteries arising from the aorta in small specimens from fetal and infantile subjects;

Secondly, a progressive age-related increase in the calibre of the aorta, resulting in moulding of structures, so that a conus artery arising initially from the proximal segment of the right coronary artery is carried onto the aorta; and

Thirdly, postnatal budding of the conus artery from the aorta.

We are confident that conus arteries arising from the aorta in the fetal and infantile specimens were not overlooked to any significant degree, if at all. This potential error was minimised by the use, in studying small specimens, of a stereoscopic dissecting microscope and, in many cases, by independent examination by two observers with identical findings.

If the higher incidence of aortic origin of the conus artery in the 2 to 4 year age group than in younger subjects were dependent upon progressive increase in the calibre of the aorta, then the incidence might be expected also to show a progressive increase in subjects older than 4 years, in concert with progressive widening of the aorta with age. This was not seen, but peculiarities in growth of the aorta in the young may differ from that in older subjects, leaving widening of the aorta with conal ostial migration as a possibility that cannot be denied.

The third potential explanation, that of budding of a conus artery from the aorta in the 2 to 4 year age group, while attractive, is considered unproved by the data.

Whichever explanation is correct, our findings indicate that, contrary to the suggestion of Reiner and associates,<sup>2</sup> some coronary arterial patterns are not firmly established at the time of birth.

## References

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